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# COMPARATIVE STUDY OF HEMODYNAMIC EFFECTS OF ROCURONIUM AND VECURONIUM DURING INDUCTION OF ANESTHESIA AND TRACHEAL INTUBATION IN PATIENTS UNDERGOING CARDIAC SURGERY

Anaesthesiology

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## ABSTRACT

**Background:** Muscle relaxants are used to provide surgical relaxation and to facilitate endotracheal intubation. Vecuronium and rocuronium decrease the heart rate and should be preferred in patient with faster baseline heart rate. **Aim:** To assess and compare the hemodynamic effects of Rocuronium Bromide and Vecuronium Bromide during induction of anaesthesia and endotracheal intubation in patients undergoing cardiac surgery **Material & Method:** Fifty patients of either sex above the age of fourteen years of ASA physical status I, II or III scheduled for elective cardiac surgery were enrolled. The patients were divided into two equal groups of 25 each - Group "V" Vecuronium bromide (0.1 mg. /kg.) and Group "R" Rocuronium bromide (0.9 mg./kg). Hemodynamic parameters were specifically recorded at various time intervals basal, after Thiopentone sodium, after relaxant during intubation and 2, 5 and 10 minutes post intubation period. **Results:** In Group V, the mean heart rate had a significant rise 2-minute post intubation. Mean SAP continued to fall after diazepam administration but the fall became statistically significant 5 & 10 minutes post intubation, similar to mean DAP pressure and MAP, but the fall became statistically significant only at 5 & 10 minutes post intubation. While, in Group R the mean heart rate showed minimal change from the base line recording and the value remained statistically insignificant at all intervals. Mean SAP showed a sudden fall after Thiopentone administration (statistically significant). The rest of the readings were insignificant statistically. **Conclusion:** Rocuronium was found to be more hemodynamically stable than Vecuronium.

## KEYWORDS

Vecuronium, Rocuronium, Heart Rate (HR), Systolic Arterial Pressure (SAP), Diastolic Arterial Pressure (DAP), Mean Arterial Pressure (MAP).

## INTRODUCTION:

Muscle relaxants are one of the three main groups of drugs forming the pillars of balanced anaesthesia; the other two are hypnotics and analgesics. Therefore the search of ideal muscle relaxant is continuing since long time1. Muscle relaxation is used to provide surgical relaxation and to facilitate endotracheal intubation.

### Vecuronium

Savage recognized that the muscarinic receptor activity resided in the quaternary group at one end (the A ring) and the neuromuscular blocking activity resided separately in the other quaternary group (the D ring).2 Savage came up with vecuronium (a 'clean drug' devoid of cardiac effects) by demethylation of the A ring nitrogen. Vecuronium had an intermediate duration of action and a slow onset.

With recent introduction of rocuronium bromide, ORG-9426, a non depolarizing agent with a quick onset and intermediate duration of action, almost all disadvantages of Vecuronium were claimed to be eliminated. Rocuronium has the onset time comparable to succinylcholine.

### Rocuronium, rapacuronium

Rocuronium is a deacetoxy analogue of vecuronium. It was found that Rocuronium, in appropriate doses, has a speed of onset only marginally slower than that of suxamethonium. It has an intermediate duration of action and depends on the kidney and liver for elimination. Rapacuronium is a recently developed analogue of vecuronium with a rapidity of onset that comes close to that of suxamethonium.3The drug has now been withdrawn after its introduction into clinical practice reported several instances of severe bronchospasm.

The major advantage of rocuronium is its use in facilitating tracheal intubation by its rapid onset of action. Rocuronium when compared to Vecuronium and atracurium produces clinically acceptable intubating conditions which are more rapid and of better quality[4].

In India, heart disease is a common condition. It is likely that rocuronium (an analogue of vecuronium) with mild vagolytic action leading to small increase in heart rate, similar duration of action to vecuronium, a favorable recovery pattern, and noncumulative property may be beneficial. These hemodynamic effects have mostly been described in patients undergoing cardiac surgery. Vecuronium and rocuronium decrease the heart rate and should be preferred in patient with faster baseline heart rate. In terms of intubating conditions rocuronium and vecuronium provide best conditions, but onset is faster with rocuronium.

## AIM:

To assess and compare the hemodynamic effects of Rocuronium Bromide and Vecuronium Bromide during induction of anaesthesia and endotracheal intubation in patients undergoing cardiac surgery

## MATERIALS & METHOD:

The present study was conducted at the Department of Anaesthesiology, National Institute of Medical Sciences and Research Center, Jaipur. After taking approval from Hospital Ethics Committee, all patients were assessed preoperatively and informed consent for the study was obtained.

Fifty patients of either sex above the age of fourteen years of ASA physical status I, II or III scheduled for elective cardiac surgery were enrolled for the present study. Patients with known associated renal, hepatic, metabolic or neuromuscular disorder and known history of hypersensitivity to drugs were excluded from the study. Those receiving drugs known to interact with neuromuscular blockade and pregnant patients were also excluded from the study.

## METHOD

Pre anaesthetic check up included detailed history taking and physical examination. The Laboratory examination including haemogram, blood sugar, SGOT, SGPT, S. bilirubin, S. urea and S. creatinine and urine examination were done. Chest X-ray, ECG, 2-D Echocardiography and whenever indicated coronary angiography was done. The weight and height of the patient were also noted.

After explaining the procedure and risk to the patients an informed and written consent was taken.

Premedication in the form of narcotic (morphine in dose of 0.1mg/kg, 1M), sedative (diazepam in dose of 0.1 mg/kg, orally) and Chlorpromazine (25-50 mg, 1M) was given. On arrival at the operation theater, chest leads were placed and connected to the monitor for continuous ECG display. Peripheral, central and arterial cannulas were also placed. The patients were preoxygenated with 100% oxygen. Inj. Fentanyl 1-2 ug/kg I.V. was slowly given via the central line. After two minutes 2.5% of Inj. Thiopentone Sodium 3-4 mg/kg. I.V. was given.

The patients were divided into two equal groups of 25 each, depending on the non-depolarizing muscle relaxant used in following doses-

Group "V" Vecuronium bromide (0.1 mg. /kg.)
Group "R" Rocuronium bromide (0.9 mg./kg)

After one to three minute (according to muscle relaxant used), Laryngoscopy & Intubation was performed. After endotracheal intubation, chest was auscultated bilaterally to assess the proper positioning of the tube. The cuff of the tube was inflated to avoid any leakage. Anaesthesia was maintained with oxygen, muscle relaxant, inhalational agent and opiates. A nasopharyngeal temperature probe and a nasogastric tube were put. An indwelling Foley's catheter connected to an urobag was used to monitor urine output throughout surgery.

Hemodynamic parameters comprising of heart rate, systolic, mean and diastolic blood pressure, central venous pressure, along with three ECG leads, Sp02, ETC02, activated clotting time, arterial blood gas, urine output and temperature were continuously monitored.

Hemodynamic parameters were specifically recorded at various time intervals basal, after Thiopentone sodium, after relaxant during intubation and 2, 5 and 10 minutes post intubation period. All observations were recorded in the specially made Performa.

In open heart surgery, the patient underwent a cardiopulmonary bypass and all relevant details viz. sternotomy time, total bypass time, aortic cross clamp time, the doses of administered drugs, urine output on bypass and after bypass etc. were also recorded.

Post - operatively the patients were closely monitored for vitals viz. heart rate, systolic arterial pressure; diastolic arterial pressure, central venous pressure, respiratory rate and urine output were noted hourly for 24 hrs. in intensive cardiac care unit.

**Statistical Analysis**
The data was analyzed at the end of the study using standard statistical methods of, mean, standard deviation and student's t-test etc.

**Results:**
In the current study the parameters recorded were Heart Rate, Systemic Arterial Pressure, Diastolic Arterial Pressure and Mean Arterial Pressure. The basal parameters were noted before medication. The readings were recorded one minute after Thiopentone, after relaxant during intubation i.e. either Vecuronium (Group - V) or Rocuronium (Group - R). Parameters were also recorded 2, 5 and 10 minutes post intubation and at the time of shifting the patient to the ward. Maximum number of patients (38%) underwent Coronary artery bypass grafting (Off cardiopulmonary bypass).

**Table 1: The Table given below depicts the mean heart rate at various time intervals**

| | Group "V" | Group "R" |
|---|---|---|
| | Mean ± S.D. | Mean ± S.D. |
| Basal | 88.56 ± 18.89 | 94.66 ± 22.59 |
| After Thiopentone | 93.10 ± 16.48 | 91.70 ± 17.70 |
| After relaxant, during intubation | 94.24 ± 16.92 | 96.30 ± 18.47 |
| 2 minute after intubation | 100.28 ± 17.47 | 102.38 ± 17.78 |
| 5 minute after intubation | 86.44 ± 12.86 | 99.34 ± 15.01 |
| 10 minute after intubation | 84.72 ± 15.25 | 92.38 ± 12.99 |

It was found that in after administration of Thiopentone and Vecuronium in Group V, an insignificant rise in heart rate was observed from the basal pre-induction value and 2 minute after endotracheal intubation the heart rate further increased to the mean value of 100.28 per minute from that of basal value of 88.56 beats / minute. The heart rate gradually decreased as observed after 5 and 10 minutes of intubation as seen in table [1].

While, in Group "R", after Rocuronium administration as well as after 2 minute of intubation the heart rate showed a minimum rise, which gradually decreased at 5 and 10 minute post- intubation period.

**Table 2: The Table given below depicts the mean Systolic Arterial Pressure (SAP) and the mean Diastolic Arterial Pressure (DAP) at various time intervals in Group V and Group R**

| | Mean SAP | | Mean DAP | |
|---|---|---|---|---|
| | Group "V" | Group "R" | Group "V" | Group "R" |
| | Mean ± S.D. | Mean ± S.D. | Mean ± S.D. | Mean ± S.D. |
| Basal | 120.48 ± 23.51 | 119.86 ± 16.00 | 73.68 ± 10.96 | 70.00 ± 10.60 |
| After Thiopentone | 115.00 ± 17.77 | 109.00 ± 12.60 | 69.80 ± 10.65 | 69.20 ± 13.60 |
| After relaxant, during intubation | 116.00 ± 20.62 | 117.00 ± 15.60 | 70.20 ± 12.39 | 68.54 ± 13.51 |
| 2 minute after intubation | 114.70 ± 16.88 | 122.52 ± 16.53 | 61. 12 ± 15.75 | 78.90 ± 15.01 |
| 5 minute after intubation | 104.94 ± 14.99 | 116.68 ± 15.71 | 66.38 ± 11.93 | 72.48 ± 14.70 |
| 10 minute after intubation | 111.00 ± 14.07 | 116.00 ± 12.70 | 69.02 ± 11.90 | 70.52 ± 13.36 |

Table 2 depicts the changes in systolic arterial pressure and diastolic arterial pressure at various time intervals in both the groups.

For systolic arterial pressure, in both the groups' minimal fall from basal value were recorded till after administration of the relaxant. The systolic arterial pressure continued to fall gradually till after 10 minutes post intubation in group "V".

On the other hand in group "R", a slight rise in systolic arterial pressure was observed 2 minutes after Endotracheal intubation. The systolic arterial pressure came towards the basal value 5 and 10 minutes after intubation.

For diastolic arterial pressure, in group "V", mean diastolic pressure after administration of Vecuronium, 2, 5 and 10 minutes after intubation showed a fall from the basal value.

On the other hand in group "R", after Rocuronium the mean diastolic pressure showed a significant rise for 2 minute after intubation to 78.90 mm Hg from the basal mean of 68.54mm Hg. The mean diastolic pressure after 5 and 10 minutes of intubation remained almost near basal value.

**Table 3: The Table given below depicts the Mean Arterial Pressure (MAP) at various time intervals in Group V and Group R**

| | Mean Arterial Pressure (MAP) | |
|---|---|---|
| | Group "V" | Group "R" |
| | Mean ± S.D. | Mean ± S.D. |
| Basal | 87.44 ± 10.18 | 80.78 ± 13.12 |
| After Thiopentone | 84.90 ± 10.05 | 82.50 ± 10.50 |
| After relaxant, during intubation | 85.74 ± 10.35 | 80.60 ± 12.62 |
| 2 minute after intubation | 84.84 ± 13.01 | 94.14 ± 13.42 |
| 5 minute after intubation | 79.20 ± 11.84 | 85.14 ± 13.37 |
| 10 minute after intubation | 81.94 ± 12.42 | 83.74 ± 11.40 |

Table 3 shows that mean arterial pressure (Mean ± SD) after Vecuronium administration show a continued fall till 10 minutes after intubation.

Whereas after Rocuronium administration the mean arterial pressure is not affected much except for a rise at 2 minutes after endotracheal intubation.

**Table 4: The Table given below depicts the Statistical Analysis of the Vital Parameters at various time intervals in Group V and Group R**

| | Mean HR | | Mean SAP | | Mean DAP | | Mean AP | |
|---|---|---|---|---|---|---|---|---|
| | Group "V" | Group "R" | Group "V" | Group "R" | Group "V" | Group "R" | Group "V" | Grou p "R" |
| After Thiopentone | Insig. | Insig. | Insig. | <0.001 | Insig. | Insig. | Insig. | Insig. |
| After relaxant, during intubation | Insig. | Insig. | Insig. | Insig. | Insig. | Insig. | Insig. | Insig. |
| 2 minute after intubation | <0.01 | Insig. | Insig. | Insig. | Insig. | <0.01 | Insig. | <0.05 |
| 5 minute after intubation | Insig. | Insig. | <0.001 | Insig. | <0.01 | Insig. | <0.05 | Insig. |
| 10 minute after intubation | Insig. | Insig. | <0.01 | Insig. | <0.05 | Insig. | <0.01 | Insig. |

Table 4 depicts the statistical analysis of vital parameters at various time intervals in Group V (Vecuronium) and Group R (Rocuronium).

In Group V, the mean heart rate remained statistically insignificant at the recorded intervals except for a significant rise 2-minute post intubation. The mean systolic arterial pressure continued to fall after diazepam administration but the fall became statistically significant 5 & 10 minutes post intubation. The same applied to the recordings for mean diastolic arterial pressure and mean arterial pressure, but the fall became statistically significant only at 5 & 10 minutes post intubation.

While, in Group R the mean heart rate showed none or minimal change from the base line recording and the value remained statistically insignificant at all recorded intervals. The mean systolic arterial pressure showed a sudden fall after Thiopentone administration, which was statistically significant. The rest of the readings were insignificant statistically. The mean diastolic arterial pressure and the mean arterial pressure showed a statistically significant rise at 2 minute post intubation but the values become statistically insignificant thereafter till 10 minutes post intubation.

## DISCUSSION:

Cardiovascular effects of muscle relaxant may be produced by muscarinic receptor block, ganglion block, increased nor adrenaline release and blockade of its uptake, or histamine liberation. Neuromuscular blocking agents vary widely with regard to their cardiovascular effects. Vecuronium and Rocuronium are associated with high degree of cardio stability.

In the present study in Group "V", an insignificant rise in heart rate was observed from the basal induction value after Thiopentone administration. The values were 88.80 and 93.10 after Thiopentone and Vecuronium respectively as compared to the basal value of 88.56. After two minute of endotracheal intubation the heart rate further increased to mean value of 100.28 beats / minute. The rise in heart rate two minute after intubation was significant statistically. Similar rises in heart rate have been reported by Agoston and colleagues (1980)7 and Robertson et al (1983)5.

In Group "R", after Rocuronium administration, heart rate increased to 96.30 beats / minute from the basal value of 94.66 beats / minute. The values after Thiopentone till after administration of Rocuronium were not statistically significant. After two minute of intubation, heart rate increased to 102.38 but was insignificant statistically. The heart rate fell to 99.34 beats / minute and 92.68 beats / minute at 5 and 10 minutes post intubation which was again statistically not significant.
Similar to the present study McCoy et al (1983)6 Levy et al (1994)7 and Nitischmann et al (1994)8 found no significant alteration in hemodynamics after Rocuronium administration.

In the present study after administration of Vecuronium a fall in systolic arterial pressure was seen. Pre-induction systolic arterial pressure was 120.48 mm of Hg and after Thiopentone it dropped to 115.00 mm of Hg. After Vecuronium it was 116.00 mm of Hg and then it fell down gradually to 114.70 and 109.94 mm of Hg after 2 and 5 minutes of intubation respectively. Fall in systolic arterial pressure was seen throughout but the drop at 5 and 10 minutes post intubation was significant statistically (p value $<0.05$).

Similar to the present study Sutherland et al (1983)9 also observed fall in systolic arterial pressure after Vecuronium. Morris et al (1983)10 and Rorvik et al (1988)11 showed that Vecuronium has a large margin of safety between the neuromuscular and vagal blocking effects and shows cardiovascular stability even when used in higher doses.

In Group "R" an insignificant fall in systolic arterial pressure to 116.00 mm of Hg was seen after Thiopentone, from the pre - induction value of 119.86. After Rocuronium administration systolic arterial pressure decreased to 116.60 mm of Hg immediately after giving relaxant but subsequently it rose and after two minute of intubation it was 122.52 nun of Hg. After 5 and 10 minutes of intubation systolic arterial pressure were 116.68 and 116.00 mm of Hg respectively.

The changes in systolic arterial pressure were statistically insignificant.

It has been shown by Jhonstone (1978)12 that Tubocurarine has a direct myocardial depressant effect, which has not been seen with any other muscle relaxant.

In our study in Group "V", a fall in Mean diastolic pressure from the pre induction value of 73.68 was observed. The values were 69.80 and 70.20 mm Hg after Thiopentone and Vecuronium respectively. A statistically significant fall to 61.12 mm of Hg was observed two minute after intubation. The value of 5 and 10 minutes post intubation were 66.38 and 69.02 mm of Hg respectively, which depicts a gradual fall in the mean diastolic pressure

Similar fall in arterial pressure was observed by Rorvik et al (1988)11 while comparing large doses of Vecuronium (0.3 mg /kg) with Pancuronium (0. mg/kg) for prolonged neuromuscular blockade.

In Group "R" the values of diastolic blood pressure after Thiopentone was 69.20 mm of Hg, which approximated with the pre-induction value of 70.00 mm of Hg. After Rocuronium was administered, the mean diastolic pressure fell down to 68.54 mm of Hg, which failed to reach any statistical significance.The mean diastolic pressure remained high after 5 minutes of intubation but came to the basal value (70.52) by 10 minutes post intubation.

Studies by Levy and Colleagues (1994)8, Naguib et al (1995)13 and Nitischmann et al (1994)7 have reported no significant alteration in mean diastolic pressure after Rocuronium administration similar to the present study.

In Group "V" the mean arterial pressure fall to 84.90 mm of Hg after Thiopentone, in comparison to the pre-induction value of 87.44. After Vecuronium administration and two minute after intubation, a fall to 85.74 and 84.84 respectively was observed. The fall was statistically insignificant. However, a significant fall in mean arterial pressure occurred after 5 and 10 minute of intubation. Similar finding have been reported by Sutherland et al (1983)9, Morris et al (1983)10 and Gallo et al (1988)[14].

In Group "R" the value of mean arterial pressure was nearly the same till after administration of Rocuronium. However it rose to 94.14 mm of Hg. two minute after intubation from the pre-induction value of 80.78 mm of Hg, which was statistically significant. After 5 and 10 minutes of intubation mean arterial pressure started to fall and came towards pre-induction value and this change was of no statistical significance.

Similar to the present study Robertson et al (1994)15 found 10 - 15% increase in the mean arterial pressure after administration of 0.9 mg /kg of Rocuronium.

In the present study Rocuronium was found to be more hemodynamically stable than Vecuronium.

## CONCLUSION:

Based on the results of the present study, it can be concluded that Rocuronium is found to be the superior hemodynamically (in respect to heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure) stable muscle relaxant than Vecuronium.

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